Appl. No. 09/607,807
Amdt. sent May 6, 2004
Reply to Office Action of February 6, 2004

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1   1.   (Currently amended): A storage system comprising:

2   ~~a first computer system having~~ a first storage component comprising a first disk

3   system, the first disk system comprising a first disk control unit and one or more first disk units;

4   and

5   ~~a second computer system having~~ a second storage component comprising a

6   plurality of second disk systems, each second disk system comprising a second disk control units

7   and one or more second disk units,

8   the first and second storage components configured to exchange data over a data

9   network,

10   the first ~~computer~~ disk system ~~having a memory that is configured with program~~

11   ~~code to write a block of data to the first storage component~~ configured to receive a block of data

12   from a host computer and to transmit a data packet to one of the second ~~computer~~ disk systems,

13   the data packet including the block of data, a time stamp, and a sequence number,

14   each of the second ~~computer~~ disk systems configured ~~having a memory that is~~

15   ~~configured with program code~~ to receive data packets from the first ~~computer~~ disk system, to

16   receive a limit time value from a predetermined one of the second disk systems based on time

17   stamps and sequence numbers contained in the data packets, to select a candidate data packet

18   from among its received data packets by comparing their associated time stamps to the limit time

19   value~~based on time stamps and sequence numbers contained in the data packets~~, and to write the

20   candidate data packet on ~~the~~ one of its second disk units~~storage system~~,

21   wherein blocks of data written on the first storage component are written on the

22   second storage component in the same order as on the first storage component.

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1   2.   (Currently amended): The system of claim 1 wherein <u>each of the second</u>

2 <u>disk systems produces a candidate limit time, wherein the limit time value is the earliest time</u>

3 <u>among the candidate limit times</u>~~the second memory is further configured with program code to~~

4 ~~obtain a limit time stamp from among the time stamps based on their corresponding sequence~~

5 ~~numbers and to select the candidate data packet from among the data packets by comparing their~~

6 ~~corresponding time stamps against the limit time stamp.~~

1   3.   (Original): The system of claim 1 wherein the data network is a

2 connectionless network.

1   4.   (Original): The system of claim 1 wherein the data network is

2 characterized as being unable to guarantee that data packets will be received in the same order as

3 they were sent.

1   5.   (Original): The system of claim 4 wherein the data network is a wide area

2 network.

          6 - 7. (Canceled)

1   8.   (Currently amended): The system of claim ~~7~~<u>1</u> wherein ~~each of the first~~

2 ~~disk systems comprises plural first disk units and each of the second disk systems comprises~~

3 ~~plural second disk units,~~ each of the first disk units ~~being~~<u>is</u> associated with one of the second

4 disk units.

1   9.   (~~Original~~<u>Currently amended</u>): The system of claim 8 wherein each first

2 disk unit is associated with one of the second disk units independently of the ~~first~~<u>second</u> disk

3 system to which the ~~first~~<u>second</u> disk unit belongs.

1   10.   (Currently amended): A method of ~~backing up data contained in~~ operating

2   a storage system that includes a local disk system ~~to~~ and a remote disk system, comprising:

3   ~~writing~~ receiving a block of data to be written to a first local disk unit among a

4   plurality of local disk units in a local data store in the local disk system;

5   sending a data packet to a first remote disk unit among a plurality of remote disk

6   units in a first remote data store from among a plurality of remote data stores in the remote disk

7   system, the data packet including the block of data, a time stamp, and a sequence number,

8   wherein the first local disk unit and the first remote disk unit defines a remote copy pair;

9   ~~receiving data packets from the local system; and~~

10   in the first remote data store, performing steps of:

11   receiving from a predetermined remote data store a limit time, the limit

12 time being determined based on the sequence numbers and the time stamps of its data

13 packets; and

14   selecting a data packet whose block of data is to be written on a remote

15 data store by comparing the time stamp of each of its data packets against the limit time~~,~~

16 ~~based on the sequence numbers and the time stamps of the data packets~~.

1   11.   (Original): The method of claim 10 further including incrementing the

2   sequence number for a next data packet.

         12 - 13.   (Canceled)

1   14.   (Currently amended): The method of claim ~~13~~ 10 further including

2   writing plural blocks of data to the local disk units and sending plural data packets to the remote

3   disk units so that each remote disk unit has a list of sequence numbers from its associated plural

4   data packets, the method further including, for each list of sequence numbers, obtaining a longest

5   run of sequence numbers, obtaining the highest-valued sequence number from the longest run,

6   and obtaining the time stamp corresponding to the highest-valued sequence number, thereby

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7   producing a list of time stamps, the method further including selecting a data packet based on the

8   earliest time stamp in the list of time stamps.

15 - 16.   (Canceled)

1   ~~18~~17. (Renumbered, Currently amended): The method of claim ~~16~~ 10 wherein

2   each of the local disk unit<u>s</u> is associated with one of the remote disk units independently of the

3   local disk system to which the local disk unit belongs.

1   ~~19~~18. (Renumbered, Currently amended): The method of claim 10 wherein

2   ~~writing~~ <u>receiving</u> a block of data ~~to a~~<u>at the</u> local <u>disk system</u>~~data store~~ and sending a data packet

3   to the remote <u>disk</u> system are performed asynchronously.

1   ~~20~~19. (Renumbered): The method of claim 10 wherein the data packets are sent

2   over a connectionless data network.

1   ~~21~~20. (Renumbered): The method of claim 10 wherein the data packets are sent

2   over a data network that is characterized as being unable to guarantee that data packets will

3   arrive at a destination in the same order as they were sent.

1   ~~22~~21. (Renumbered, Currently amended): The method of claim ~~21~~20 wherein

2   the data network is a wide area network.

1   ~~23~~22. (Renumbered, Currently amended): In a local storage system comprising

2   ~~plural~~<u>a</u> local data store~~s~~, a method for backing up data in the local storage system to a remote

3   storage system comprising plural remote data stores, the method comprising:

4   ~~each~~<u>at the</u> local data store, receiving a data block to be written thereto;

5   ~~each~~<u>at the</u> local data store transmitting a data packet comprising the data block, a

6   time stamp, and a sequence number to one of the remote data stores;

7   at the remote data stores, receiving plural data packets from the local data stores,

8   wherein each remote data store has its associated plural data packets and a list of sequence

9   numbers and a list of time stamps from the associated data packets;

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10   at each remote data store, identifying a longest run of sequence numbers and

11   ~~obtaining the~~ an obtained data packet ~~of~~ having the highest-valued sequence number of the

12   longest run of sequence numbers;

13   ~~at each remote data store, obtaining the earliest time stamp from the obtained data~~

14   ~~packet;~~

15   ~~selecting the earliest of the obtained time stamps as a limit time;~~

16   at a predetermined remote data store, identifying a limit time from among time

17   stamps associated with obtained data packets from the remote data stores;

18   at each remote data store, selecting a candidate data packet having the earliest

19   time stamp; and

20   ~~selecting the~~ identifying a selected data packet from among the candidate data

21   packets whose time stamp is earlier than the limit time and writing the selected data packet to

22   one of the remote data stores.

~~24~~23.   (Renumbered, Canceled)

1   ~~25~~24.   (Renumbered, Currently amended): The method of claim ~~24~~22 wherein

2   ~~each~~ the local data store ~~is one of the~~ a plurality of local disk drives and each remote data store ~~is~~

3   ~~one of the~~ a plurality of remote disk drives, each local disk drive being associated with one of the

4   remote disk drives to define a remote copy pair, wherein there is a sequence number associated

5   with each remote copy pair.

1   ~~26~~25.   (Renumbered, Currently amended): The method of claim ~~25~~24 wherein

2   the received plural data packets are grouped according to remote copy pair.

~~27~~26.   (Renumbered, Canceled)

1   ~~28~~27.   (Renumbered, Currently amended): The method of claim ~~27~~25 wherein

2   each of the plural data packets is grouped based on the local disk ~~system~~ drive from which it was

3   sent.

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1   2928. (Renumbered, Currently amended): The method of claim 24 wherein each

2   remote copy pair is associated with one of a plurality of data integrity pair groups, wherein a

3   sequence number is associated with each pair of local and remote disk systems drives which

4   have a common data integrity pair group.

          3029 - 32. (Renumbered, Canceled)